AIR QUALITY

ATIKOKAN
KENORA
RED ROCK

Annual Report, 1979

Ministry
of the
Environment

Ontario

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TECHNICAL SUPPORT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT

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SUMMARY

ATIKOKAN

A long-term joint air quality monitoring programme involving the Ministry and two iron ore mining companies was wound up in early 1979, due to the termination of both companies' operations.

Dustfall and sulphation rate data for the first quarter of the year were generally similar to those for other years. Total suspended particulate matter (TSP), monitored throughout the year, also occurred at levels which did not differ significantly from those in 1977 and 1978. Only 5 percent of the daily values of TSP exceeded the Ontario objective, and the annual mean was well below the maximum acceptable limit.

KENORA

For the fourth consecutive year, vegetation around a local sulphite pulp mill showed no evidence of sulphur dioxide injury symptoms in 1979.

Dustfall, attributed mainly to lignite ash fallout, sometimes exceeded provincial regulations near the mill. An existing control order specifies that this problem must be resolved by early 1982.

RED ROCK

Emissions of particulate matter from a kraft pulp mill resulted in dustfall levels which sometimes were above desirable limits in the town of Red Rock. Saltcake (sodium sulphate) was a significant component of total dustfall. Particulate matter fallout from kraft pulp mills is considered a nuisance, but not a health hazard.

Elevated sulphation rates, experienced periodically throughout the year, indicated that concentrations of malodorous gases reached levels which might have caused annoyance or temporary discomfort to local residents. A brief survey conducted in 1978 with mobile monitoring equipment confirmed that levels of these gases exceeded the Ontario guideline. A control order issued in early 1980 requires that emissions of particulate matter and pollutants causing offensive odours are to comply with Ministry regulations by late 1983.

PREFACE

This report describes air quality investigations undertaken in 1979 by the Ontario Ministry of the Environment, Northwestern Region, in Atikokan, Kenora and Red Rock. There is no common link between the studies or the three communities in which the work was conducted. The reports are combined into one document simply for convenience; each is too small to be printed and bound separately.

The scope of the work carried out during the year is outlined in the introduction to the section pertaining to each of the three communities.

MONITORING METHODS

Dustfall and sulphation rate measurements were carried out in all three communities considered in this report. In addition, a high-volume sampler was operated to monitor suspended particulate levels in Atikokan.

Dustfall comprises particulate matter that settles out from the atmosphere by gravity. The Ministry measures dustfall by exposing open-top plastic jars to the air for 30-day periods and then weighing the collected matter. In 1979, the soluble fraction of dustfall was analysed for total iron and soluble sulphate at Atikokan, for soluble calcium and sulphate at Kenora, and for soluble calcium, sodium, and sulphate in Red Rock. Determinations of total dustfall and all dustfall analyses were performed at the Ministry's Thunder Bay laboratory.

Suspended particulate matter constitutes particles of small size which remain in the atmosphere for extended periods. Every sixth day at Atikokan, a measured volume of air is drawn through a fibreglass filter which is weighed at the Ministry's Thunder Bay laboratory before and after the 24-hour sampling period. The difference in filter weight represents the total suspended particulate matter collected.

Sulphation rates provide a semi-quantitative estimate of average monthly levels of sulphur-containing gases in the atmosphere. The method, described in earlier reports (1, 2), is based on the chemical conversion of lead dioxide to lead sulphate. It is non-specific and readings are obtained in the presence of several reactive compounds. The results may also be strongly influenced by variations in temperature, wind speed and humidity. Despite these limitations, the method is useful in determining the presence and extent of elevated sulphur concentrations, and in determining long-term trends.

ATIKOKAN

INTRODUCTION

Since 1964, Steep Rock Iron Mines Limited, Caland Ore Limited and the Ontario Ministry of the Environment have participated in a long-term joint environmental monitoring programme in the vicinity of two iron ore mines and pelletizing plants near Atikokan. These studies (1, 3) showed that iron ore dust was the principal contaminant associated with mining and milling operations. No significant adverse effects, other than aesthetic, could be documented in the area where dust levels were elevated. Air quality monitoring investigations were, therefore, gradually reduced in 1976, 1977 and 1978. By agreement with the mining companies, all air quality studies, except measurement of suspended particulate matter, were terminated on March 31, 1979. Steep Rock ceased operations in August, 1979, and Caland Ore closed its pelletizing plant in April, 1980.

AIR QUALITY MONITORING

Dustfall

Total dustfall, and iron and sulphate in dustfall at seven monitoring stations (Figure 1) are reported in Table 1 for the first quarter of 1979. Some higher-than-normal dustfall was

recorded in January, and was accompanied by elevated sulphate concentrations. Values for February and March were typical. Iron, expressed as iron oxide, accounted for a significant proportion of total dustfall during these months.

Suspended Particulate Matter

Data, in Table 3, from the Ministry's sampler at the Atikokan Weather Station show three values above the 24-hour provincial objective, compared with one each in 1977 and 1978. The annual mean of 36 $\mu g/m^3$ (micrograms of particulate matter per cubic metre of air) was well within the maximum acceptable limit of 60 $\mu g/m^3$. Tree pollen was conspicuous on filters exposed on June 8 and June 14. Road dust was considered the main cause of elevated readings on August 1 and August 25. Since average concentrations were the same for both north and south prevailing wind, there was no evidence that mining operations contributed significantly to levels of suspended particulate matter in Atikokan.

Sulphation Rate

All values were low throughout the study area (Table 2) and were similar to those found in other years. The data indicate that average levels of sulphur dioxide were acceptable.

ONTARIO HYDRO PROJECT

Construction continues on the 400-megawatt, coal-fired power plant near Marmion Lake, about 8 km (kilometres) north of Atikokan. Ontario Hydro and the Ministry are collaborating in a comprehensive air and water quality monitoring programme to ensure that all provincial environmental regulations are met. Pre-operational air quality studies are due to begin in late 1980, and will continue until the scheduled start-up date of the plant in 1983. Post-operational investigations will be undertaken throughout the life of the generating station.

KENORA

INTRODUCTION

The Ministry has conducted air quality assessment investigations in Kenora for the past 10 years, to assess the effects of emissions from a local sulphite pulp mill. In the early 1970's, sulphur dioxide discharged from the mill caused periodic vegetation damage. This problem was corrected several years ago. Occasionally, fallout of particulate matter emitted from the mill's power boiler stack was a nuisance to nearby residents. The Ministry's 1979 assessment programme included inspection of vegetation, and the operation of a small network of dustfall jars and sulphation plates.

VEGETATION ASSESSMENT

Two visits, in early June and late July, revealed no evidence of sulphur dioxide injury to any vegetation around the mill. Air pollution damage to plant life has not been recorded in the area since 1975. Trembling aspen and Manitoba maple trees sustained some light insect injury, but there was no damage from forest tent caterpillars.

AIR QUALITY MONITORING

Dustfall

Total dustfall recorded at the four Kenora monitoring sites (Figure 2) is presented in Table 4. The monthly air quality objective for dustfall was exceeded at least once at each location, but the annual averages were acceptable except at station 61007, northeast of the mill. At this and other sites, low readings were obtained in the first quarter of the year when no lignite was burned at the mill. When lignite use was resumed, there was a significant increase in dustfall. Examination of insoluble dustfall from station 61007 in April, May and June showed that approximately 60 percent of total dustfall at this site during these

months was lignite ash. About 10 percent of dustfall was bark char. Sulphate in dustfall was at normal background levels at all locations. Calcium was slightly elevated at station 61007.

A comparison of dustfall averages for 1979 with those for other years (Table 5) suggests that some improvement may have occurred. Under provisions of an existing control order, emissions of particulate matter from the mill's lignite coal power boilers must comply with Ontario regulations by March, 1982. Until then, noticeable quantities of lignite ash and bark char fallout may occur periodically near the mill. Neither of these contaminants is a threat to health, nor toxic to vegetation or soils.

Sulphation Rate

Sulphation rate averages for 1979 in Kenora (Table 6) were a little lower than those in 1978, but no significant change has been detected for the past 3 years. Some readings (eg. at station 61003 in December) were well above background levels, but values during the growing season, when most vegetation is susceptible to injury, were not considered excessive.

RED ROCK

INTRODUCTION

Surveys in 1976, 1977 and 1978 showed that a local kraft pulp mill at Red Rock was a source of significant emissions of particulate matter and reduced sulphur compounds (3, 4). In April, 1978, a small, permanent network of dustfall and sulphation monitors was installed. Measurement of particulate matter and sulphation rates continued in 1979.

AIR QUALITY MONITORING

Dustfall

Table 7 summarizes results for 1979 for the sites shown in Figure 3. The monthly objective was exceeded frequently at

station 63082, occasionally at stations 63080 and 63081, but not at all at site 63083, the monitoring location most distant from the mill. Annual averages, plotted in Figure 4, complied with the Ontario regulation at only one station. While calcium in dustfall was generally low, significant quantities of sodium and sulphate were found at the two sites where the impact of fallout from the mill was greatest. Expressed as sodium sulphate (saltcake), these two components accounted for approximately 40 to 50 percent of total dustfall at these locations. The unusually high reading in April at station 63081 was mainly due to wood fibres, which constituted about two-thirds of the sample weight.

Monitoring in 1978 and 1979 indicates that the Red Rock mill is a source of significant particulate fallout which sometimes exceeds Ministry regulations. Local dustfall might cause a nuisance effect but, at the levels recorded, is not considered harmful to public health or vegetation. Under provisions of a recently issued control order, particulate emissions from the mill must be reduced to acceptable levels no later than the end of 1983.

Sulphation Rate

Sulphation rate readings are given in Table 8 and the averages are plotted in Figure 5. The results for 1978 and 1979 were similar, with the highest values being recorded at stations 63080 and 63082, and the lowest measurements at 63081 and 63083. Only at Brompton Road (site 63083) were the values consistently low.

The sulphation data are supported by information from a mobile monitoring survey, the results of which recently became available (5). This study was conducted during a brief period in August, 1978, and yielded just over 40 hours of data from continuous monitoring equipment. TRS (total reduced sulphur) levels exceeded the Ministry guideline of 27 ppb (parts of TRS per billion parts of air, expressed as hydrogen sulphide) for 4 of the 41 hours of monitoring. The maximum half-hour average TRS concentration was 130 ppb, approximately five times the guideline. Analysis of the

TRS by gas chromatography revealed that hydrogen sulphide comprised 86 percent of the TRS mixture. Very little sulphur dioxide or nitrogen oxides were found to be emitted from the kraft mill.

The elevated sulphation readings recorded periodically at three of the four Red Rock monitoring stations, together with data from surveys with mobile equipment in 1977 and 1978, confirm that unacceptable levels of offensive odours occur from time to time in the townsite area. The highest concentrations of these sulphur-containing gases might cause temporary discomfort to some members of the local population, but no chronic or long-term effects would be anticipated. The current control order issued to the mill requires that emissions of reduced sulphur compounds be satisfactorily controlled by late 1983.

ACKNOWLEDGEMENTS

The Ministry wishes to thank Steep Rock Iron Mines Limited and Caland Ore Limited for their operation of the dustfall and sulphation monitoring network at Atikokan from 1964 to 1979. The continuing assistance of staff of the Atmospheric Environment Service, Atikokan Weather Station, in operating a high-volume sampler is also gratefully acknowledged.

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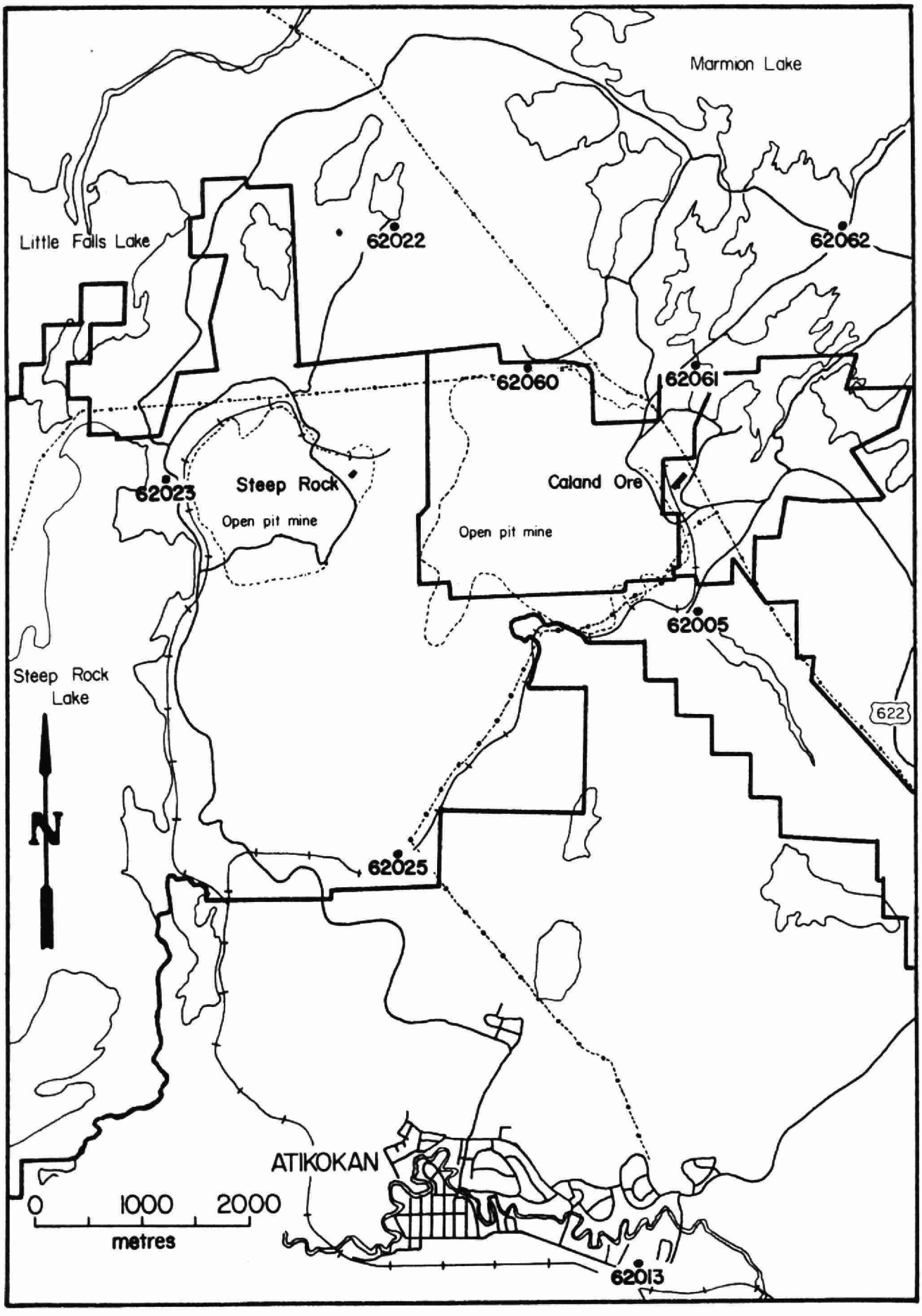

Figure 1. Air quality monitoring sites, Atikokan, 1979 (except station 62063).

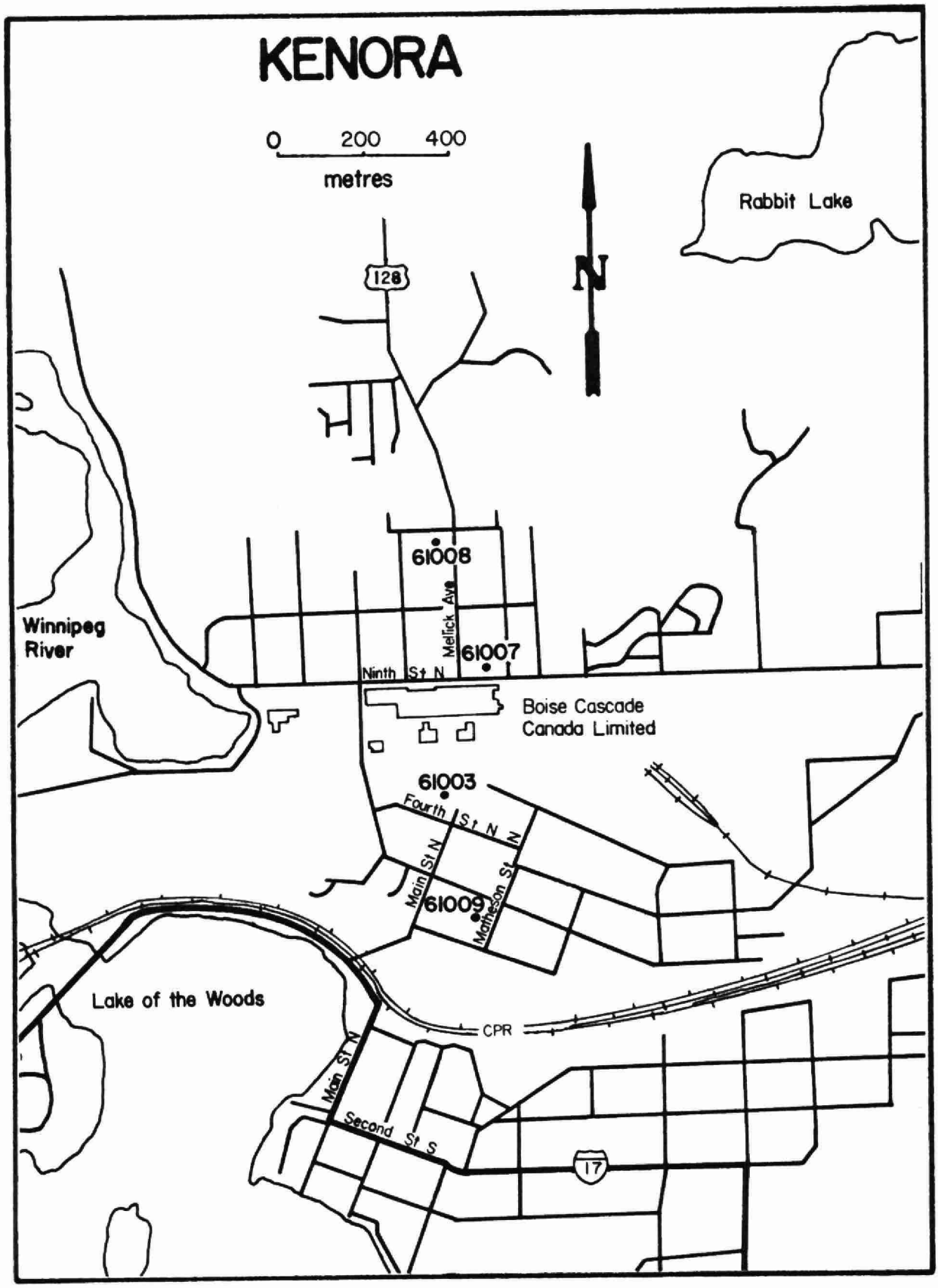

Figure 2. Air quality monitoring sites, Kenora, 1979.

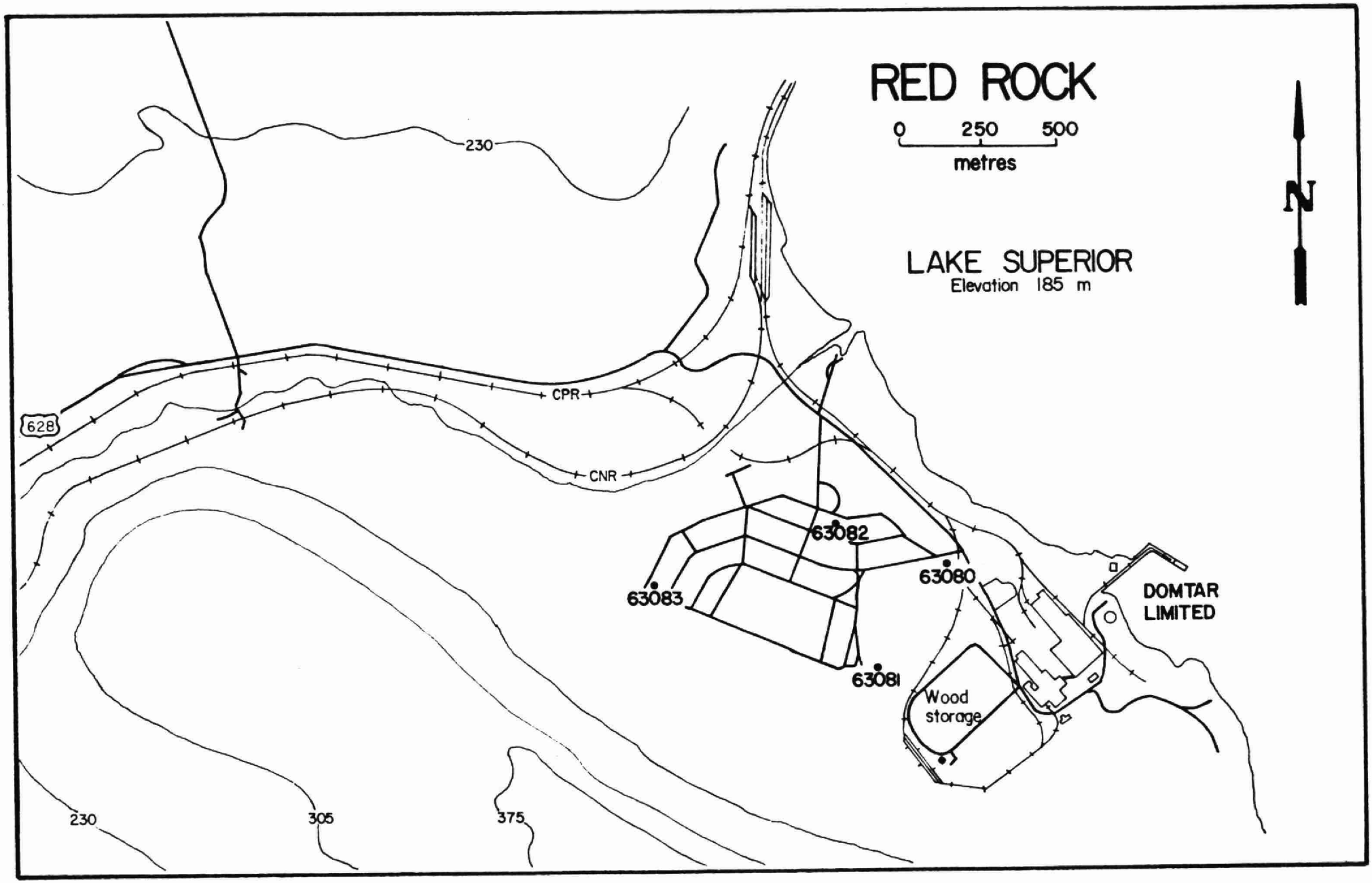

Figure 3. Air quality monitoring sites, Red Rock, 1979.

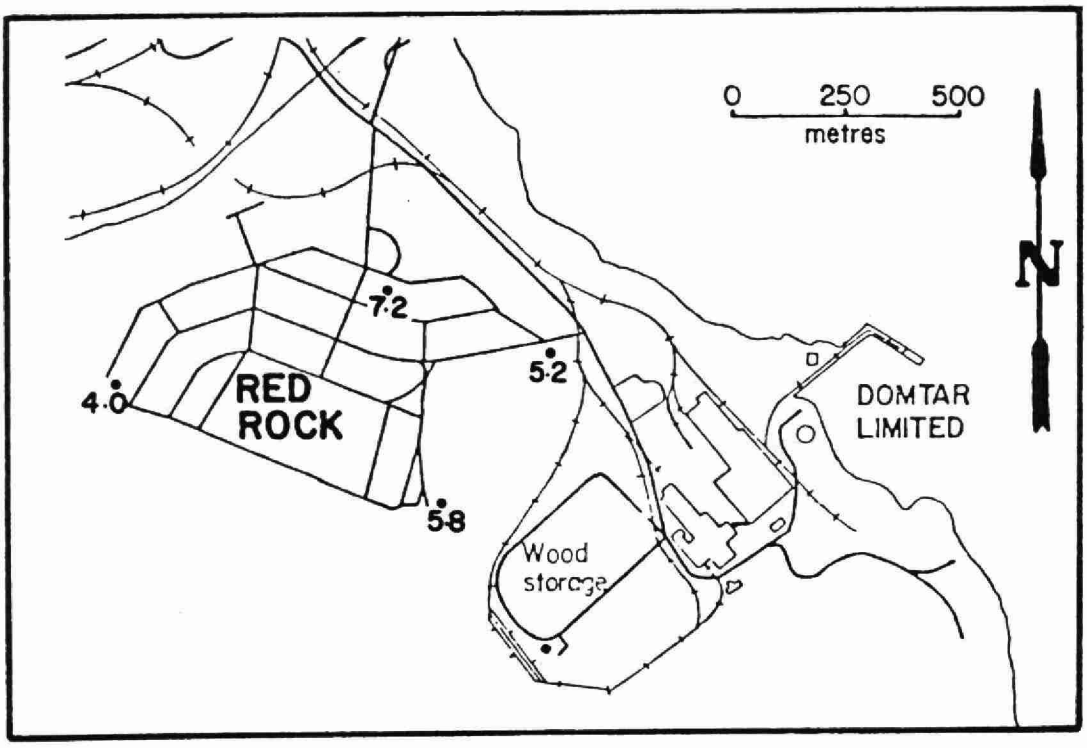

Figure 4. Average dustfall (g/m^2/30 days), Red Rock, 1979.

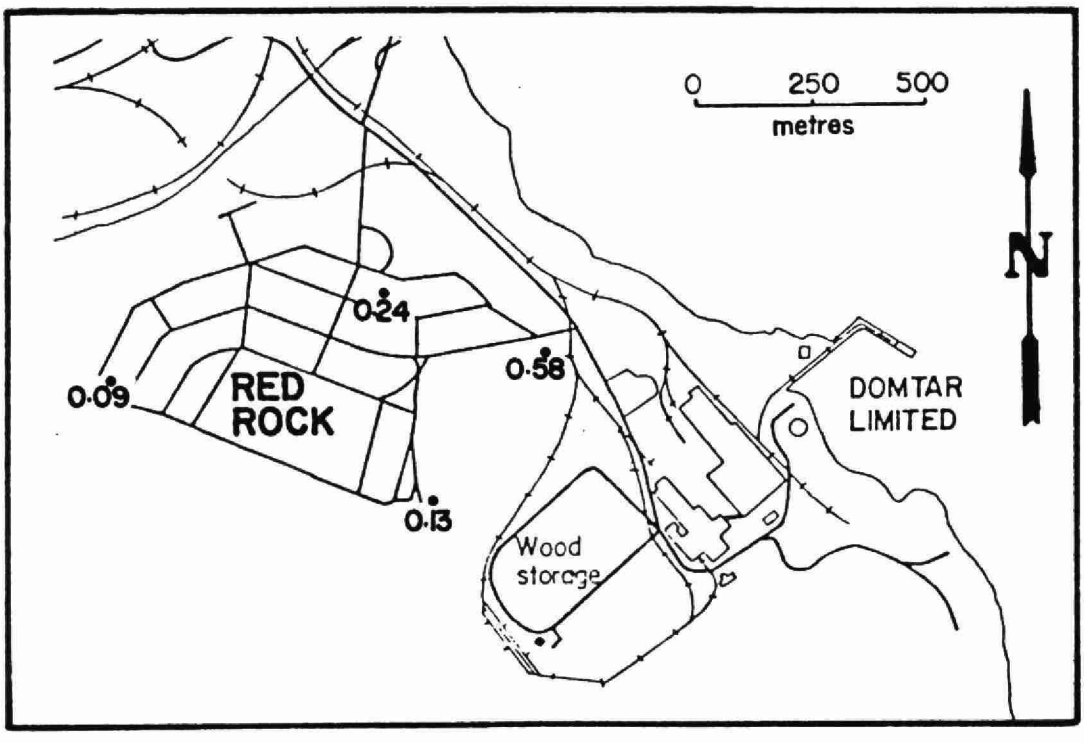

Figure 5. Average sulphation rate (mg SO_3 / 100 cm^2/ day), Red Rock, 1979.

TABLE 1. Dustfall (g/m^2/30 days) in Atikokan, 1979.

Station	Total dustfall			Soluble sulphate in dustfall			Total iron in dustfall		
	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar
62005	7.3	2.4	2.5	0.1	< 0.1	0.2	0.9	0.2	0.5
62013	1.7	-	1.9	0.1	< 0.1	0.2	0.2		0.2
62022	7.9	2.0	1.8	3.2	0.1	0.1	0.1	0.2	< 0.1
62023	10.8	1.2	2.2	3.3	< 0.1	0.2	0.4	0.3	< 0.1
62025	9.0	1.6	2.3	3.5	0.2	0.1	0.3	0.4	< 0.1
62060	3.3	1.9	4.4	0.1	< 0.1	0.2	0.3	0.4	0.8
62061	2.3	3.5	4.1	0.1	0.1	0.2	0.3	0.5	0.6

TABLE 2. Sulphation rate (mg SO_3/100 cm^2/day) in Atikokan, 1979.

Station	Location	January	February	March
62005	Fairweather	-	0.03	0.11
62013	Atikokan	-	0.01	0.18
62022	Mary Lake	0.02	0.02	0.10
62023	Water Tower	0.04	0.01	0.03
62025	Pal Lake Road	< 0.01	< 0.01	< 0.01
62060	Lime Point	-	0.04	< 0.01
62061	Moose Lake Dam	-	0.09	< 0.01
62063	Nym Lake	0.03	0.06	0.02

TABLE 3. Total suspended particulate matter ($\mu g/m^3$), station 62013, Atikokan, 1979.

Date	$\mu g/m^3$	Wind[a]	Date	$\mu g/m^3$	Wind
Jan 3	12	W 13	Jul 2	56	E 3
9	17	W 8	8	57	S 5
15	25	ESE 4	14	58	W 13
21	-		20	102	SW 12
27	8	NNE 6	27	75	W 3
Feb 2	15	S 2	Aug 1	169	SW 5
8	25	NNE 2	7	55	WNW 12
14	12	N 9	13	23	SVRL 15
20	45	ENE 2	19	72	NNE 1
26	14	S 9	25	171	W 5
			31	26	SE 8
Mar 4	18	NNE 10			
10	13	W 13	Sep 6	23	N 12
16	31	SSW 8	12	67	SSW 4
22	19	SVRL[b] 5	18	51	N 12
28	17	E 8	24	94	WNW 11
			30	98	W 8
Apr 3	75	WNW 5			
9	70	SVRL 2	Oct 6	33	N 7
15	19	NW 8	12	18	N 16
21	24	NNW 8	18	114	SE 5
27	41	N 5	24	70	SE 7
			30	28	ESE 5
May 3	32	NW 17			
9	22	SVRL 6	Nov 5	65	NNW 5
15	77	N 5	11	19	S 2
21	32	SVRL 4	17	30	ESE 1
27	-		23	42	ENE 5
			29	17	NW 14
Jun 2	43	WSW 13			
8	73	NNW 5	Dec 5	19	N 12
14	136[c]	SVRL 11	11	-	
20	43	SE 12	17	30	W 2
26	60	SVRL 16	23	16	E 5
			29	20	W 2

[a] prevailing wind direction and average wind speed (kph) recorded 10 m above ground level

[b] several

[c] values exceeding maximum acceptable level of 120 $\mu g/m^3$ (24-hour average) are underlined

TABLE 4. Total dustfall (g/m^2/30 days), Kenora, 1979.

Station	Location	Distance (metres) and direction from source[a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
61003	Fourth/Main	140 S	0.6	3.1	1.9	5.2	5.2	4.2	5.1	4.3	6.3	8.9[b]	7.6	2.6	4.6
61007	Melick/Ninth	225 NE	0.7	0.6	3.8	8.7	15.2	11.0	10.5	11.3	9.7	-	15.4	7.6	8.6
61008	Melick/Eleventh	475 N	0.3	0.5	1.9	8.1	3.3	7.8	6.0	2.5	5.8	-	1.3	4.4	3.8
61009	Third/Matheson	500 S						5.3	4.5	6.2	8.4	14.6	5.8	3.7	

[a]source arbitrarily designated as digester relief stack, Boise Cascade Canada Limited sulphite pulp mill

[b]values exceeding maximum acceptable levels of 7.0 (monthly) or 4.6 (annual average) are underlined

TABLE 5. Comparison between average annual dustfall (g/m^2/30 days) in Kenora from 1974 to 1979.

Station	Location	1974	1975	1976	1977	1978	1979
61003	Fourth/Main	6.3[a]	5.6	4.2	5.7	9.5	4.6
61006	Matheson/Fourth	5.2	4.2	3.5	4.4	4.9	
61007	Melick/Ninth	14.4	7.7	8.4	11.9	14.7	8.6
61008	Melick/Eleventh	6.3	6.0	3.2	3.7	5.3	3.8

[a]values exceeding maximum acceptable level of 4.6 (annual average) are underlined

TABLE 6. Sulphation rates (mg SO_3/100 cm^2/day), Kenora, 1979.

Station	Location	Distance (metres) and direction from source[a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
61003	Fourth/Main	140 S	.08	.25	.12	-	.13	.13	.06	.39	.25	.48	.24	.57	.24
61007	Melick/Ninth	225 NE	.04	.06	.10	.05	.23	-	.39	.18	.20	.21	.27	-	.17
61008	Melick/Eleventh	475 N	.07	.09	.09	.07	.24	.20	.27	.17	.43	.14	.12	.28	.18
61009	Third/Matheson	500 S						.03	.08	.12	.09	.11	.09	.13	

[a]source arbitrarily designated as digester relief stack, Boise Cascade Canada Limited sulphite pulp mill

TABLE 7. Dustfall (g/m^2/30 days), Red Rock, 1979.

Station	Location	Distance (metres) and direction from source[a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
			Total dustfall												
63080	Rankin Street	550 NW	1.4	5.1	7.6[b]	5.3	8.5	5.0	9.4	-	-	2.8	4.2	2.4	5.2
63081	Stewart/Frost	550 W	2.5	2.8	5.0	17.7	9.0	3.8	3.7	7.8	4.5	6.0	3.3	3.3	5.8
63082	47 Timmins Street	875 NW	1.3	6.1	6.6	6.0	9.6	7.2	10.6	8.7	10.1	11.4	5.4	3.6	7.2
63083	122 Brompton Road	1300 WNW	1.8	2.5	2.7	4.5	5.3	3.8	3.8	6.9	2.2	5.1	3.5	6.3	4.0
			Soluble sodium in dustfall												
63080	Rankin Street	550 NW	0.1	1.1	1.2	0.7	0.4	0.5	1.5	-	-	1.0	0.3	0.6	0.7
63081	Stewart/Frost	550 W	0.2	0.1	0.5	0.5	0.3	0.3	0.4	0.5	0.7	0.4	0.3	0.4	0.4
63082	47 Timmins Street	875 NW	0.1	0.5	1.7	0.7	0.4	0.6	1.4	1.6	1.7	2.3	0.8	0.7	1.0
63033	122 Brompton Road	1300 WNW	0.2	0.5	0.5	0.8	0.2	0.3	0.4	0.4	0.3	0.6	0.2	0.4	0.4
			Soluble sulphate in dustfall												
63080	Rankin Street	550 NW	0.2	1.8	2.4	1.3	2.2	0.9	2.9	-	-	1.7	0.6	0.9	1.5
63081	Stewart/Frost	550 W	0.4	0.8	1.1	1.1	1.4	0.7	1.0	1.1	0.8	0.8	0.4	0.6	0.8
63082	47 Timmins Street	875 NW	0.2	1.9	2.2	1.3	2.2	1.3	2.4	1.9	3.2	3.7	1.6	0.8	1.9
63083	122 Brompton Road	1300 WNW	0.3	0.8	1.1	1.3	1.0	0.6	0.9	0.8	0.4	0.8	0.3	0.5	0.7

[a] source arbitrarily designated as recovery furnace stacks, Domtar kraft pulp mill

[b] values exceeding maximum acceptable levels of 7.0 (monthly) or 4.6 (annual average) are underlined

TABLE 8. Sulphation rates (mg SO_3/100 cm^2/day), Red Rock, 1979.

Station	Location	Distance (metres) and direction from source[a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
63080	Rankin Street	550 NW	.07	.34	.48	.39	.87	.97	.70	-	-	.85	.02	1.10	.58
63081	Stewart/Frost	550 W	.03	.10	.12	-	.14	.17	.17	.17	.13	.12	.04	.23	.13
63082	47 Timmins Street	875 NW	.03	.13	.24	.08	.48	.45	.18	.20	.24	.48	.02	.22	.24
63083	122 Brompton Road	1300 WNW	.02	.07	.08	.09	.12	.18	.13	.04	.06	.10	< .01	.13	.09

[a]source arbitrarily designated as recovery furnace stacks, Domtar kraft pulp mill

TERMINAL STREET

DATE	ISSUED TO